length. In such an embodiment, the microchannel 42 would be sized with a width and depth of about 0.010 to 0.020 inches. Preferably, the AST test array 12 is constructed of a moldable plastic material like styrene, but other types of material can be used. Most preferably, the material used in constructing array 12 is generally translucent, so as to allow uninterrupted transmission of light through microwells 124 during AST testing in the microbiological analyzer 10. AST testing may conveniently be accomplished by directing a beam of interrogating radiation from above or below each AST array 12 through a upper central arc portion 157 of the top surface 150 of each microwell 124 and measuring the degree of absorption or change in color or generation of a fluorescent signal using a colorimetric or fluorometric photodetector located below or above each microwell 124. For this reason, the upper center portion 157 of the top surface 150 of every microwell 124 and the lower center portion 159 of the top surface 150 of every microwell 124 are molded so as to have a surface finish smoothness equivalent to or more smooth than SPI #A-1 grade #3 diamond buff in order to minimize optical interference.

The sacrificial evaporation well 132 is designed to accomplish two important purposes: firstly, provision of a evaporation chamber 148 from which sacrificial evaporation of inoculum-broth solutions may take place, thereby inhibiting evaporation of solution from microwells 124. Evaporation from microwells 124 is inhibited because evaporation initially must occur from within short microchannel 130 and then from the sacrificial evaporation chamber 148 before evaporation might occur from long microchannel 142 and microwells 124. Evaporation chamber 148 further provides the sealable vacuum port 138 through which air contained within microwells 124 may be evacuated so that air within microwells 124 does not bubble through broth in the reservoir 134 during evacuation and generate air bubbles within inoculum-broth solutions. After evacuation, vacuum port 138 is subsequently sealed so as to generate a flow of inoculum-broth solution from reservoir 134 into the microwells 124.

In an alternate embodiment of AST array 12 illustrated in Fig. 5C showing the top view of an AST array 12, taken in conjunction with Fig. 6A, showing the bottom view of an AST array 12, sacrificial evaporation well 132 may be separated from vacuum port 138 but connected thereto by a microchannel 131. Fig 5D is a cross-section view along lines D-D of Fig. 5C and shows such a separated arrangement of sacrificial evaporation well 132 and vacuum port 138 in an embodiment in which vacuum port 138 is seen as

14 or within a sample tube 34 by a vortex mixer 93 described in co-pending U. S. patent application Ser. No.: 09/703,139. The mixing member 254 may be caused to rapidly move by revolving an off-center magnetic field source 258 having sufficient magnetic strength at high speed in a generally circular pattern in close proximity to broth container 14 or sample tube 34. When the magnetic field source 258 is revolved as shown beneath broth container 14, the mixing member 254 is caused to move so as to minimize the distance separating the mixing member 254 from the magnetic field source 258. Revolution of the magnetic field source 258 causes the mixing member 254 to revolve within broth/sample solution 264 thereby generating a vortex-like mixing motion of broth/sample solution 264. In the embodiment described, a disk 266 encases magnetic field source 258 as shown. In the exemplary embodiment shown in FIG. 13, the magnetic field source 258 comprises a permanent or semi-permanent magnet 258 and magnetic mixing member 254 is caused to revolve by rotating the permanent or semi-permanent magnet 258 at close proximity to the broth container 14 using a mixing motor 260 with a mixing motor shaft 262 having the disk 266 attached thereto. The term ferromagnetic is intended to mean a substance having a sufficiently high magnetic permeability to be positionally affected by an orbiting or rotating magnetic field.

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FIGS. 14A-14B are ~~FIG. 14 is~~ a perspective view of a closed elongate broth canister 24 having a generally rectangular cross-section (FIG. 14A ~~14B~~) formed by a broth canister front wall 320, ID canister back wall 321 and two ID canister side walls 322, the front wall 320, back wall 321 and side walls 322 of essentially similar dimensions so that a squarely shaped interior is formed to house a plurality of broth containers 14 stacked one atop another. A top end portion 324 and a bottom end portion 326 close the ends of broth canister 24. Typically, broth canister 24 is formed as an indented sheet of plastic and is folded in half creating a external rib 325 extending the full length of broth canister 24 between broth canister back wall 321 and a side wall 322 (FIG. 14B). An opposed elongate broth canister seal flange 323 is created in a sealing operation and also extends the full length of broth canister 24 between broth canister back wall 321 and a side wall 322. A number of surface bumps 328 are formed in opposing pairs of finger pads 327 formed in top end portion 324 to facilitate handling of a broth canister 24 by an operator. FIG. 14B is a sectional view of broth canister 24 and best illustrates the broth canister seal flange 323, broth canister external rib 325 and internal ribs 328.

Key features of the broth canister 24 include a broth canister mounting flange 324 shaped to seat into a mounting groove 331 (FIG. 1) within B/ID chamber 28 so that a broth canister 24 may be placed using a number of finger pads 327 in a vertical position whereat two spring-loaded latching cams within B/ID chamber 28 snap over latch steps 329 formed at opposing ends of a latching flange 330 extending upwardly above top end portion 324. The portion of latching flange 330 between steps 328 is confined between spring-loaded latching cams to provide proper vertical orientation. FIG. 14A is an enlarged view of the bottom end portion 326 of broth canister 24 showing details of a broth eject port 332 formed in broth canister front wall 320 proximate mounting flange 324 and sized to allow the lowermost broth container 14 within the plurality of broth containers 14 stacked one atop another to be pulled out of broth canister 24. Broth containers 14 may be pulled out of broth canister 32 through broth eject port 332 by broth clamping members 109 located at the end of moveable broth arms 238 of broth robotic device 108 (FIG. 21). Broth eject port 332 has the shape of a rectangular opening formed between a pair of depressions 334 having a flat portion 336 between the depressions 334. The flat portion 336 functions as a horizontal broth container sliding surface to support broth containers 14 as they are pulled out of broth canister 24 through broth eject port 332. A tongue flap projection 338 formed in front wall 320 extends downwardly and partially into the eject port 332 to prevent broth containers 14 from being dislodged accidentally from canister 24 and also to prevent broth containers 14 from being improperly inserted back into canister 24.

FIGs. ~~15A-15M~~ 15A-15H and 15J-15M illustrate the operation of sample pipetting and transport system 60 of FIG. 3 in filling the AST test arrays of FIG. 5 in the previously mentioned AST carrier 74 "build and fill" process. FIGs. ~~15A-15L~~ 15A-15H and 15J-15L are simplified so as to clearly illustrate important improvements in high speed filling of AST test arrays 12 and AST test microwells 124 with liquid sample aspirated from sample tubes 34 by pipetting apparatus 46, and are an important advantage of the present invention, being derived from the single pipetting apparatus 46 being operational in two opposed directions along the single linear path defined by the loci L of positions 46a-46e as defined above such that AST test arrays 12 may be filled with sample-inoculum at a plurality of positions along loci L.

Beginning with FIG. 15A, an AST carrier 74 partially loaded with AST test arrays 12 and supported on AST array carrier bed 80B is seen positioned between AST carrier

transporter 76 and AST array dispenser 84. In these FIGs., two identical AST array carrier beds are identified as 80A and 80B for purposes of discussion. AST array carrier bed 80A is seen as being empty in FIG. 15A. As discussed earlier, AST array dispenser 84 is adapted to remove AST test arrays 12 from an AST canister 18 in the form of a singulated stream and to successively place the AST arrays 12 within a number of empty AST array slots 86 formed within an AST carrier 74 as the AST carrier 74 is advanced along a first direction on carried by AST array carrier bed 80B (arrow pointing "upwards" in FIG. 15A for purposes of illustration) as controlled by CPU 15. As indicated by the "upwards" direction of movement arrows, hereinafter called the "upwards direction", the empty AST carrier bed 80A is seen "ahead" of AST carrier 74 on the AST array carrier bed 80B that is partially loaded with AST test arrays 12. The purpose of FIGs. 15A-15M is to describe how high speed filling of AST test arrays 12 is accomplished as a result of the pipetting apparatus 46 operating in two opposed directions along the loci L defined by positions 46a-46e taken with AST test arrays 12 being filled with sample-inoculum at a plurality of positions also along loci L. For purposes of clarity, AST array carrier transport 78 is shown only once in dashed lines in FIG. 15B and its two directions of travel are as indicated by a double-ended arrow even though the AST array carrier transport 78 is in each of FIGs. 15A-15H and 15J-15M ~~15A-15M~~.

FIG. 15B illustrates a subsequent stage of loading AST carrier 74 with AST arrays 12, a stage in particular whereat a fourth AST array 12 is being loaded onto AST array carrier 74; pipetting apparatus 46, having aspirated an amount of inoculum-broth solution from a broth container 14, is at position 46d and deposits a known amount of inoculum-broth solution into reservoir 134 of the first AST test array 12 loaded onto AST array carrier 74. As described before, pipetting apparatus 46 is controlled by CPU 15 between a third position, 46c, for aspirating a known amount of inoculum-broth solution from broth container 14 after the sample and broth are properly mixed together and a fourth position, 46d, for depositing a known amount of sample and broth into an AST test array 12. As will be described in conjunction with these FIGs. 15A-15H and 15J-15M ~~15A-15M~~, pipetting apparatus 46 "chases" AST array carrier 74 upwards or downwards as required so as to deposit inoculum-broth into all AST test arrays 12 carried by AST array carrier 74, eliminating the requirement that AST arrays 12 be filled at a stationary position(s). Because pipetting apparatus 46 "chases" AST array carrier 74 to deposit inoculum-broth into the AST test

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array filling process to continue without stopping by automatically proceeding to the AST array 12 filling stages depicted by FIGs. ~~15A-1M~~ 15A-15H and 15J-15M.

It should be understood that the feature of analyzer 10 in which a single pipetting apparatus 46 operational in two opposed directions along a single linear path defined by the loci of positions 46a-46d as defined above provides a degree of compactness in layout in addition to minimizing the amount of time required in the AST array filling process.

FIG. 19 illustrates AST array dispenser 84 adapted to remove or eject AST test arrays 12 from an AST canister 18 in the form of a singulated stream of AST test arrays 12 and to successively place each of the AST arrays 12 within an empty AST array slot 86 formed within an AST array carrier 74. AST array dispenser 84 comprises a pushrod 368 controlled by CPU 15 to displace an AST array 12 from an AST canister 18 and into contact with an array alignment wall 360 and between the alignment wall 360 and an array guide 362 to precisely position the lowermost AST test array 12 within an empty parallel slot 86 in an AST array carrier 74. Array guide 362 is biased towards array alignment wall 360 by array guide spring 364 to maintain alignment of an AST array 12 being moved from an AST canister 18 into an empty AST array slot 86 during the process of loading AST arrays 12 onto a AST array carrier 74. An AST array lifter 369 is also located below and between the alignment wall 360 and the array guide 362 to lift an AST array 12 above the base 75 of carrier 74 (FIG. 17) as the AST array 12 is placed within an empty AST array slot 86 in order to protect the layer of adhesive film along the bottom surface 120 of AST array 12 previously mentioned.

FIG. 20 illustrates one of several alternate embodiments of a AST carrier transport 78 adapted to transport an empty AST carrier bed 80 or an AST carrier bed 80 having an AST array carrier 74 totally filled with AST arrays 12 or partially loaded with AST arrays 12 during the loading process of FIG. 15. In one embodiment, AST carrier transport 78 comprises at least one AST carrier transport take up roller 380 which drives a belt 382 in two directions along a linear path over upper operating plate 11 as illustrated in FIG. 15. Both AST carrier beds 80 are fastened to the AST carrier transport belt 382 using pins 386. AST carrier transport belt 382 is moved along a linear path beneath sample pipetting and delivery system 60 during which movement AST carriers 74 may be loaded with AST arrays 12, and AST arrays 12 may be filled with a known amount of inoculum-